Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Decomposition of multi-scale coherent structures in a turbulent boundary layer by variational mode decomposition[1] WENKANG WANG, CHONG PAN, JINJUN WANG, Fluid Mechanics Key Laboratory of Ministry of Education, Institute of Fluid Mechanics, Beihang University — Turbulent boundary layer (TBL) is believed to contain a wide spectrum of coherent structures, from near-wall low-speed streaks characterized by inner scale to log-layer large-scale coherent motions (LSM and VLSM) characterized by outer scale. Recent studies have evidenced the interaction between these multi-scale structures via either bottom-up or top-down mechanisms, which implies the possibility of identifying the coexistence of their footprints at medium flow layer. Here, we propose a Quasi-Bivariate Variational Mode Decomposition method (QB-VMD), which is an update of the traditional Empirical Mode Decomposition (EMD) with bandwidth limitation, for the decomposition of the PIV measured 2D flow fields with large ROI ($\Delta x \times \Delta z \sim 4\delta \times 1.5\delta$) at specified wall-normal heights ($y/\delta = 0.05 \sim 0.2$) of a turbulent boundary layer with $Re_\tau = 3460$. The empirical modes identified by QB-VMD well capture the characteristics of log-layer LSMs as well as that of near-wall streak-like structures. The lateral scales of these structures are analyzed and their respective energy contribution are evaluated.

[1]Supported by both the National Natural Science Foundation of China (Grant Nos. 11372001 and 11490552) and the Fundamental Research Funds for the Central Universities of China (No. YWF-16-JCTD-A-05).

Wenkang Wang
BeiHang University

Date submitted: 26 Jul 2016 Electronic form version 1.4